CANCER INCIDENCE AND MORTALITY IN MASSACHUSETTS 1996-2000:

STATEWIDE REPORT

Bureau of Health Statistics, Research and Evaluation

Massachusetts Department of Public Health

April 2003

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EXECUTIVE SUMMARY

Cancer Incidence and Mortality in Massachusetts, 1996-2000: Statewide Report presents cancer incidence and mortality data for the Commonwealth from 1996 through 2000. The data include numbers and rates for twenty-three types of cancer, detailed information about the most commonly occurring types of cancer, a comparison of Massachusetts and national cancer rates, and a discussion of cancer trends. **The Massachusetts incidence data presented only include invasive cancers.** This year the trend data were analyzed with the estimated annual percent change (EAPC), a measure used by the National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) program to examine trends over time.

Highlights from the report

- From 1996 to 2000, there were 160,631 newly diagnosed cases of cancer and 69,249 deaths from cancer among Massachusetts residents. The average annual age-adjusted incidence rate was 501.2 per 100,000 persons, and the average annual age-adjusted mortality rate was 211.3 per 100,000 persons. Overall, cancer incidence in Massachusetts decreased slightly from 1996 to 2000, though the decrease was not statistically significant. Cancer mortality in Massachusetts decreased significantly by 1.8% per year during this time period.

- Prostate cancer was the most common type of newly diagnosed cancer among Massachusetts males. Prostate cancer accounted for 31% of new cancers among males in the state from 1996 to 2000. The average annual age-adjusted incidence rate of prostate cancer was 181.6 per 100,000 males. The incidence rate of prostate cancer in Massachusetts increased by 0.9% per year from 1996 to 2000, though the increase was not statistically significant.

- From 1996 to 2000, breast cancer was the most common type of newly diagnosed cancer among Massachusetts females, accounting for about 31% of new cancers among females in the state. The average annual age-adjusted incidence rate of breast cancer was 145.2 per 100,000 females. The incidence rate of female breast cancer increased by 0.2% per year in Massachusetts from 1996 to 2000, though the trend was not statistically significant.

- Cancer of the bronchus and lung was the most common cause of cancer deaths among both Massachusetts males and females between 1996 and 2000, accounting for 29% of all deaths among males and 24% of all deaths among females. During this time period, the mortality rate of cancer of the bronchus and lung in Massachusetts decreased by 2.5% for males and by 1.5% for females. The decrease was statistically significant for males, but not for females.

- For all types of cancer combined for 1996-2000, black, non-Hispanics had the highest age-adjusted incidence and mortality rate among Massachusetts males. Between 1996 and 2000, cancers of the prostate, bronchus and lung, and colon/rectum were the top three most commonly diagnosed cancers, and cancer of the bronchus and lung was the most common cause of cancer death for all Massachusetts male race/ethnicity categories.

- For all types of cancer combined for 1996-2000, white, non-Hispanics had the highest age-adjusted incidence rate and black, non-Hispanics had the highest age-adjusted mortality rate

among Massachusetts females. Cancers of the breast, bronchus and lung, and colon/rectum were the top three most commonly diagnosed cancers for all Massachusetts female race/ethnicity categories during this time period, but the order of those cancers varied by race/ethnicity. Cancer of the bronchus and lung was the most common cause of cancer death among all female race/ethnicities in Massachusetts, except Hispanic females. Breast cancer was the leading cause of death for Hispanic females.

- For all cancer sites combined, the age-adjusted incidence and mortality rates in Massachusetts were higher than their national counterparts. The age-adjusted incidence rate in Massachusetts from 1996-2000 was 501.2 per 100,000, while the age-adjusted incidence rate for the SEER areas from 1995-1999 was 468.9 per 100,000. The age-adjusted mortality rate in Massachusetts from 1996-2000 was 211.3 per 100,000, while the age-adjusted mortality rate in the United States from 1995-1999 was 206.0 per 100,000.

- From 1996 to 2000, there were statistically significant decreases in the age-adjusted incidence rates for cancers of the colon/rectum and larynx and non-Hodgkin's lymphoma for Massachusetts males and cancers of the cervix uteri and urinary bladder for Massachusetts females. During this time period, there were statistically significant increases in the age-adjusted incidence rates for cancer of the esophagus for Massachusetts males and cancer of the thyroid for Massachusetts females.

- From 1996 to 2000, there were statistically significant decreases in the age-adjusted mortality rates for all cancer sites combined, cancer of the bronchus and lung and non-Hodgkin's lymphoma for Massachusetts males and cancers of the breast, colon/rectum, and stomach for Massachusetts females. During this time period, there was a statistically significant increase in the age-adjusted mortality rate for cancer of the esophagus for Massachusetts males.

INTRODUCTION

The Massachusetts Cancer Registry (MCR) collects reports of newly diagnosed cases of cancer and routinely compiles summaries of cancer incidence and mortality data. This report, *Cancer Incidence and Mortality in Massachusetts, 1996-2000: Statewide Report,* is produced annually with statewide data. An electronic version of this report may be found on the Internet at http://www.state.ma.us/dph/bhsre/mcr/canreg.htm#statewide. Another report, the *Cancer Incidence in Massachusetts: City and Town Supplement*, is also produced annually and contains information for the 351 cities and towns in Massachusetts. The most recent *City and Town Supplement* may be found on the Internet at http://www.state.ma.us/dph/bhsre/mcr/canreg.htm#supplement.

Content

This report:

- provides statewide information on cancer incidence and mortality in Massachusetts for twenty-three types of cancer and for all cancers combined for 1996 through 2000, including data by race/ethnicity;
- provides detailed information about the most commonly occurring types of cancer for 1996 through 2000, including leading cancers by race/ethnicity;
- compares Massachusetts incidence and mortality data with national incidence and mortality data;
- reviews Massachusetts cancer incidence and mortality trends for 1996 through 2000.

The Massachusetts incidence data presented include invasive cancers only.

The report is organized into the following four sections:

- **METHODS** provides a detailed explanation of the data collection, data processing and statistical techniques employed in this report and the limitations to consider when reviewing the data.
- **OVERVIEW** provides an overview of the leading types of cancer incidence and mortality in Massachusetts from 1996 through 2000 and trends in the state during that time period.
- **TABLES** presents cancer incidence and mortality data for twenty-three types of cancer, by sex, for 1996-2000. There are eleven tables in this section with breakdowns such as state vs. nation, race/ethnicity, year, and age group.
- **APPENDICES** provides information supplemental to this report, including a listing of codes used to prepare the report, population estimates, and a comparison of Massachusetts mortality data using two different conventions for analyzing data.

New Features

For the first time, Massachusetts trends were analyzed using the estimated annual percent change (EAPC). The EAPC is used by the National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) program to examine trends over time. See Technical Notes for a description of how the EAPC was calculated.

METHODS

Data Sources

Cancer Incidence

Massachusetts cancer incidence data are collected by the Massachusetts Cancer Registry (MCR). The MCR is a population-based cancer registry that was established by state law in 1980 and began collecting data in 1982. The MCR collects reports of newly diagnosed cancer cases from all Massachusetts acute care hospitals and one medical practice association (76 reporting facilities in 2000). Reporting is mandated by state law. Currently, the MCR collects information on *in situ* and invasive cancers, except basal and squamous cell carcinomas of the skin, and benign tumors of the brain and associated tissues. During the time period covered by this report, case reports were coded following the International Classification of Diseases for Oncology, Second Edition (ICD-O-2) system (1).

The activities of the MCR involve data collection efforts in collaboration with hospital tumor registrars. Intensive data evaluation is also required to ensure data quality. The fundamental requirements of any central cancer registry include: a) complete registration, b) prevention of duplication, c) collection of uniform data (i.e., standardization of items, definitions, rules, classification and nomenclature of primary site, histology, staging and procedures), d) quality control and e) efficient data processing.

For diagnosis year 1996 and onward, the MCR collects information from reporting hospitals on cases diagnosed and treated in staff physician offices, when this information is available. Not all hospitals report this type of case, however, and some hospitals report such cases as if the patients had been diagnosed and treated by the hospital directly. Collecting this type of data makes the MCR's overall case ascertainment more complete. The cancer types most often reported to the MCR in this manner are prostate cancer and melanoma.

For diagnosis year 1997 and onward, the MCR identifies previously unreported cancer cases through death certificate clearance to further improve case completeness. This process identifies cancers mentioned on death certificates that were not previously reported to the MCR. In some instances the MCR obtains additional information on these cases through follow-up activities with hospitals, nursing homes and physicians' offices. In other instances a cancer-related cause of death recorded on a Massachusetts death certificate is the only source of information for a cancer case. These "death certificate only" cancer diagnoses are therefore poorly documented and have not been medically confirmed (confirmed by review of complete clinical information). Such cases are included in this report for diagnosis years 1997-2000; they comprise less than 3% of all cancer cases for these years.

Each year the North American Association of Central Cancer Registries (NAACCR) reviews cancer registry data for quality, completeness, and timeliness. For diagnosis years 1996-1999, the MCR's total case count was estimated by the NAACCR to be complete. Data for diagnosis year 2000 have not yet been reviewed by NAACCR.

The Massachusetts data summarized in this report were drawn from cancer cases entered on MCR computer files on or before October 15, 2002 and from death certificate clearance activities completed in September 2002. The numbers presented in this report may change slightly in future reports, reflecting late reported cases or corrections based on subsequent details from the reporting facilities. Such changes might result in slight differences in numbers and rates in future reports of MCR data. This is the nature of population-based cancer registries, which receive case reports on an ongoing basis.

Massachusetts cancer cases presented in this report are primary cases of cancer diagnosed among Massachusetts residents during 1996-2000. **The Massachusetts data presented include invasive cancers only** (cancers that have spread beyond the layer of cells where they started into the tissue around them, and have the potential to spread to other parts of the body). *In situ* cases (cancers diagnosed at the earliest stage, before they have spread, when they are limited to a small number of cells and have not invaded the organ itself) are not included in the data for Massachusetts. As a standard, published incidence rates do not combine invasive and *in situ* cancers due to differences in the biologic significance of the tumors. Invasive tumors have the potential to be life threatening, and therefore have a significant impact on survival. One reason more and more cancers are detected at the *in situ* stage is advances in diagnostic technology. Massachusetts cancer site/types were grouped according to coding definitions adapted from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program (Appendix I).

The national incidence data are from the SEER program. The SEER program includes data from population-based cancer registries in 18 states and geographic areas, covering approximately 26% of the United States population. The SEER incidence data presented here were obtained from the SEER 1973-1999 public-use data (2) using the SEER*Stat 4.2.6 software and include malignant cases from 11 SEER areas covering about 14% of the United States population. Data from the 3 supplemental SEER registries and the 4 SEER registries that only recently began participating in the SEER program are not included. Unlike the MCR, SEER includes *in situ* bladder cancer cases in its age-adjusted bladder cancer incidence rates. At the time of publication, 1999 was the latest diagnosis year available from SEER. As a result, the SEER incidence rates cover the time period 1995-1999.

Cancer Mortality

Massachusetts death data are from the Massachusetts Registry of Vital Records and Statistics. The Registry has legal responsibility for collecting reports of deaths in this state. Death reports from 1996 to 1998 were coded using the International Classification of Diseases, Ninth Revision (ICD-9) (3). Death reports from 1999 and 2000 were coded using the International Classification of Diseases, Tenth Revision (ICD-10) (4).

To help make comparisons between deaths coded with ICD-9 and ICD-10, the National Center for Health Statistics (NCHS) has developed preliminary comparability ratios for leading causes of death. These comparability ratios are multipliers that adjust for changes in coding between the two revisions of ICD. Because the comparability ratio for all cancers combined is 1.0068, indicating that the number of deaths due to cancer was stable across the two revisions of ICD (5),

the SEER program does not adjust their data with the comparability ratios (personal communication).

In addition to varying on their use of the comparability ratio, the NCHS and the SEER program group cancer site/type differently. Appendix II presents a comparison of age-adjusted cancer mortality rates for Massachusetts calculated using the NCHS cancer site/type groupings and comparability ratios and the SEER cancer site/type groupings without comparability ratios. This analysis shows that age-adjusted mortality rates in Massachusetts are only slightly affected by the different conventions for analyzing mortality data.

In last year's annual report, *Cancer Incidence and Mortality in Massachusetts, 1995-1999: Statewide Report* (6), Massachusetts mortality data were adjusted with the comparability ratios, and cancer site/types were grouped according to the NCHS. However, Massachusetts death data were not compared to national death data because comparable national data were not available at the time the report was published. This year, Massachusetts death data are compared to national death data as reported by the SEER program. In order to make that comparison, Massachusetts mortality data were not adjusted with the comparability ratios, and cancer site/type for Massachusetts deaths were based on cancer site/type groupings from the SEER program in this report (Appendix I).

The national cancer mortality data are reported from the SEER program, but are based on data from the National Center for Health Statistics. The U.S. mortality data presented here were obtained from the SEER 1973-1999 public-use data (2) using the SEER*Stat 4.2.6 software. At the time of publication, 1999 was the latest year for which mortality data were available from SEER. As a result, the U.S. mortality rates cover the time period 1995-1999.

The cancer mortality data published in this report may differ from the cancer mortality data published in *Massachusetts Deaths*, the annual Massachusetts Department of Public Health mortality surveillance publication. *Massachusetts Deaths* uses comparability modified rates and age-adjustment procedures consistent with the NCHS.

Technical Notes

Age-Adjusted Rates

Massachusetts statewide incidence and mortality rates are sex-specific, age-adjusted rates per 100,000 population, and were calculated by the direct method using the 2000 U.S. Bureau of the Census population distribution as the standard. Rates were age-adjusted using 18 five-year age groups to correct for differences in the age distributions of different populations.

Age-adjusted rates can only be compared if they are adjusted to the same standard population. Age-adjusted cancer incidence and mortality rates presented in this report may differ from those in other reports which used a different standard such as the 1940 or 1970 U.S. population. Age-specific rates, crude rates, or the actual number of cases can be compared across reports. It is

also important to note that differences in methodologies used in calculating rates, such as number of age groups used, may cause slight variations in results.

Age-Specific Rates

Massachusetts statewide age-specific rates were calculated by dividing the number of people in an age group who were diagnosed with cancer or died of cancer in a given time frame by the number of people in that same age group overall in a given time frame. They are presented as rates per 100,000 residents.

Estimated Annual Percent Change (EAPC)

The estimated annual percent change (EAPC) is a measure of the percent increase or decrease in rates per year over a particular time period. The EAPC was calculated based on methods from the SEER program, which require fitting a regression line $\ln(r) = mx + b$, where $\ln(r)$ is the natural logarithm of the rates, x is the year, and m is the slope of the line, and then using the equation $EAPC = 100(e^m - 1)$ (7). A positive EAPC is indicative of an increasing trend, while a negative EAPC is indicative of a decreasing trend. All of the EAPCs calculated in this report were tested against the hypothesis that they are equal to zero (the rate is neither increasing nor decreasing). A p value is a statistical term that indicates the probability that a result is due to chance alone. In this report, a p value ≤ 0.05 was used to determine statistical significance. Here, a p value ≤ 0.05 means that there is, at most, a 5% chance that the positive or negative EAPC is due to chance alone.

Population Estimates

For the computation of Massachusetts incidence and mortality rates in this report, the statewide populations for individual years from 1996 to 1998 were based on population estimates released by the Massachusetts Institute for Social and Economic Research (MISER) in September, 2000. The 1999 and 2000 population estimates are from the Massachusetts Department of Public Health (MDPH) (8). In order to create a 1999 MDPH population file, MDPH applied a linear interpolation between the 1998 MISER population estimates and the MDPH 2000 population estimates. The MDPH 1999 file is a preliminary estimate. The MDPH population 2000 file is based upon the Massachusetts Census file, which contains data on population and housing for the 351 cities and towns, the state, and the counties for Massachusetts abstracted from the *Census 2000 SF1* file (U.S. Census, 2001). Census data were reallocated to create mutually exclusive race categories consistent with the race categories used to collect cancer incidence and cancer mortality data. Massachusetts population estimates for 1996-2000, which were used in this report, are presented in Appendix III. If different population estimates were used to calculate rates in other reports, the rates may vary slightly.

Race/Ethnicity Definitions

The race/ethnicity categories presented in this report are mutually exclusive. Cases and deaths are only included in one race/ethnicity category. The race/ethnicity tables include the categories white, non-Hispanic; black, non-Hispanic; Asian, non-Hispanic; and Hispanic.

Data Limitations

In interpreting cancer incidence and mortality data in this report, it is important to consider the following data limitations.

Border Areas and Neighboring States

Some areas of Massachusetts appear to have low cancer incidence, but this may be due to loss of cases in Massachusetts residents who were diagnosed in neighboring states and not reported to the MCR. Presently the MCR has reciprocal reporting agreements with the following fifteen states: Alaska, Arkansas, Connecticut, Florida, Maine, Mississippi, New Hampshire, New York, North Carolina, Rhode Island, South Carolina, Texas, Vermont, Wisconsin and Wyoming.

Cases Diagnosed in Non-Hospital Settings

During the time period covered by this report, the MCR's information sources for most newly diagnosed cases of cancer were hospitals. In addition, the MCR collected information from reporting hospitals on cases diagnosed and treated in staff physician offices, when this information was available. Some types of cancer in this report may be under-reported because they are diagnosed by private physicians, private laboratories, health maintenance organizations or radiotherapy centers that escape the case identification systems used by hospitals. Particular examples include melanoma of the skin, prostate cancer and certain hematologic malignancies such as leukemia and multiple myeloma. The extent of this under-reporting has not been determined exactly, but cases included in this report represent the great majority of cases statewide and provide an essential basis for evaluating statewide cancer incidence patterns.

Trends

The trend data should be interpreted with caution. Apparent increases or decreases in cancer incidence over time may reflect changes in diagnostic methods or case reporting rather than true changes in cancer occurrence. Also, cancer incidence trends may appear more favorable than they actually are because they have not been adjusted for reporting error or delay (9). Typically, statewide Massachusetts cancer incidence data are released about two years after a diagnosis year. For example, data for 2000 diagnoses are released for the first time in early 2003. The MCR continues to receive case reports on an ongoing basis even after the data are released. The delayed case reports, as well as corrections to cases based on subsequent details from the reporting facilities, result in reporting delay and error and the more recent diagnosis years may be less complete than the earlier diagnosis years. Incidence rates for 1997-2000 include cases identified only on death certificates. This addition of cases elevated incidence rates by 10% or more for certain cancers, such as pancreatic cancer and liver cancer, which have shorter survival times and may not be diagnosed and/or reported prior to death. Rates for 1997-2000 may not be directly comparable to rates for 1996 because of this inclusion of "death certificate only" cases. Finally, two important issues should be considered when interpreting the trend data. First, the source of the population estimates differs between 1996-1998 and 1999-2000. Second, the EAPC assumes that the change in rate is the same over the entire time period examined, which may or may not be true for the trends examined in this report.

Race/Ethnicity

Race/ethnicity data for cancer cases are based on information existing in the medical record. Race/ethnicity data for cancer deaths are based on information from death certificates as reported by next-of-kin and funeral directors. Errors in these source documents may lead to incorrect classification of race/ethnicity. Also, completeness of the race/ethnicity data may be different for cancer cases and cancer deaths. Some race/ethnicity categories may be under-reported if race/ethnicity is not available for all cases. Counts and rates may under-represent the true incidence of some racial/ethnic populations.

OVERVIEW

Leading Types of Cancer Incidence and Mortality

Cancer Incidence by Sex

In Massachusetts, from 1996 through 2000, there were 160,631[1] newly diagnosed cases of cancer – 79,888 in males and 80,724 in females (Table 3).

For all types of cancer combined for 1996-2000, the average annual age-adjusted incidence rate among males was 589.2 cases per 100,000 (Table 4). The most commonly diagnosed type of cancer in Massachusetts males for this time period was prostate cancer, followed by cancer of the bronchus and lung, colon/rectum and urinary bladder (Figure 1). There were 24,689 cases of prostate cancer reported from 1996-2000, accounting for 31% of all cancers diagnosed in Massachusetts males and an age-adjusted incidence rate of 181.6 cases per 100,000 (Tables 3 and 4).

For all types of cancer combined for 1996-2000, the average annual age-adjusted incidence rate among females was 446.3 cases per 100,000 (Table 4). Among Massachusetts females, the most commonly diagnosed cancer types were cancers of the breast, bronchus and lung, colon/rectum, and corpus uteri (uterus) (Figure 1). There were 25,359 cases of breast cancer reported from 1996-2000, accounting for 31% of all cancers diagnosed in females and an age-adjusted incidence rate of 145.2 cases per 100,000 (Tables 3 and 4).

In both sexes, the four leading types of cancer comprised approximately 63% of all new cancer cases for this time period (Figure 1). No other type of cancer constituted more than 5% of new cases in either sex (Table 3).

From 1996-2000, the age-specific incidence rate for all cancer sites combined increased with age, peaked among those 75-84 years old, and then declined in those 85 years old and older for both Massachusetts males and females (Table 8).

Cancer Incidence by Sex and Race/Ethnicity

For all types of cancer combined for 1996-2000, black, non-Hispanics had the highest age-adjusted incidence rate among Massachusetts males (685.3 cases per 100,000) (Table 6). The top three most commonly diagnosed cancers were the same for all Massachusetts male race/ethnicity categories. These top three cancers were prostate cancer, followed by cancers of the bronchus and lung and colon/rectum. The cancer that ranked fourth for Massachusetts males varied by race/ethnicity. The fourth most commonly diagnosed cancer was cancer of the urinary bladder for white, non-Hispanic males, stomach cancer for black, non-Hispanic males, cancer of

[1] The male and female case counts will not add up to the total case count because the MCR added two additional gender classifications (transsexuals and persons with sex chromosome abnormalities/hermaphrodites) for cases diagnosed as of January 1, 1995. Cases diagnosed before this date were limited to male or female only.

the liver and intrahepatic bile ducts for Asian, non-Hispanic males, and cancer of the oral cavity and pharynx for Hispanic males (Table 1).

For all types of cancer combined for 1996-2000, white, non-Hispanics had the highest age-adjusted incidence rate among Massachusetts females (445.3 cases per 100,000) (Table 6). Among Massachusetts females, the top four most commonly diagnosed cancers were the same by race/ethnicity, but the rank order of the second and third leading cancers varied. Breast cancer was the most commonly diagnosed cancer for all race/ethnicities, and cancer of the corpus uteri and uterus, not otherwise specified was the fourth most common cancer for all race/ethnicities. Cancer of the bronchus and lung was the second leading cancer for white, non-Hispanic and black, non-Hispanic females, but the third leading cancer for Asian, non-Hispanic and Hispanic females. Cancer of the colon/rectum was the third leading cancer for white, non-Hispanic and black, non-Hispanic females, but the second leading cancer for Asian, non-Hispanic and Hispanic females (Table 1).

Cancer Mortality by Sex

Although prostate cancer and breast cancer were the most commonly diagnosed cancers in Massachusetts males and females, respectively, these cancers ranked second in mortality for each sex. Cancer of the bronchus and lung was the leading cause of cancer death for both males and females between 1996 and 2000 (Figure 2). During this time period, cancer of the bronchus and lung accounted for 29% of all cancer deaths and an age-adjusted mortality rate of 76.3 per 100,000 in males and 24% of all cancer deaths and an age-adjusted mortality rate of 44.0 per 100,000 in females (Tables 9 and 10). The third and fourth most common types of cancer death in Massachusetts males and females for 1996-2000 were cancers of the colon/rectum and pancreas (Figure 2).

In both sexes, the four leading types of cancer comprised approximately 56% to 57% of all cancer deaths for this time period (Figure 2). No other type of cancer constituted more than 5% of cancer deaths in either sex (Table 9).

Cancer Mortality by Sex and Race/Ethnicity

For all types of cancer combined for 1996-2000, black, non-Hispanics had the highest age-adjusted mortality rate among males, with 371.8 deaths per 100,000 males (Table 12). For Massachusetts males, cancer of the bronchus and lung was the most common cause of cancer death among all race/ethnicities, and cancer of the colon/rectum was the third most common cause of cancer death among all race/ethnicities. Cancer of the prostate was the second leading causes of cancer death among white, non-Hispanic, black, non-Hispanic, and Hispanic males. Cancer of the liver and intrahepatic bile ducts ranked the second leading cause of cancer death for Asian, non-Hispanic males (Table 2).

For all types of cancer combined for 1996-2000, black, non-Hispanic females had the highest age-adjusted mortality rate with 213.3 deaths per 100,000 females (Table 12). Cancer of the bronchus and lung was the most common cause of cancer death among all female race/ethnicities, except Hispanic females. Breast cancer was the leading cause of death for

Hispanic females. Cancers of the breast and colon/rectum were the second and third leading causes of cancer death, respectively, among white, non-Hispanic, black, non-Hispanic, and Asian, non-Hispanic females. The second and third leading causes of cancer death for Hispanic females were cancers of the colon/rectum and bronchus and lung, respectively (Table 2).

Figure 1
DISTRIBUTION OF CANCER INCIDENCE BY CANCER TYPE AND SEX
Massachusetts, 1996-2000

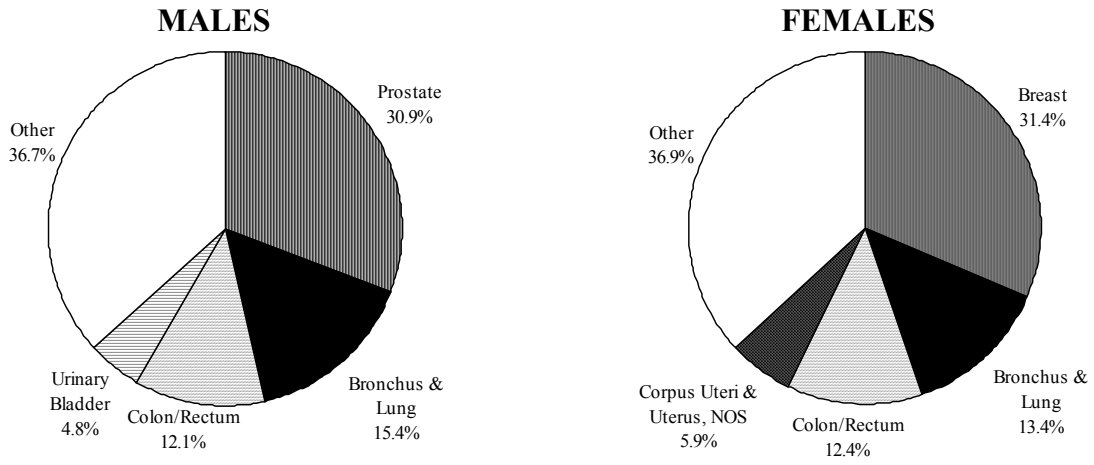


Table 1
LEADING CANCERS BY SEX AND RACE/ETHNICITY
Massachusetts, 1996-2000

MALES

RANK	AGE-ADJUSTED[1] INCIDENCE RATE[2] (% OF ALL CASES)			
	White, non-Hispanic	**Black, non-Hispanic**	**Asian, non-Hispanic**	**Hispanic**
1	Prostate 175.1 (30.5%)	Prostate 292.7 (41.0%)	Prostate 79.3 (19.8%)	Prostate 157.8 (29.7%)
2	Bronchus & Lung 91.1 (15.7%)	Bronchus & Lung 105.4 (14.6%)	Bronchus & Lung 61.4 (15.6%)	Bronchus & Lung 57.4 (11.3%)
3	Colon/Rectum 73.1 (12.4%)	Colon/Rectum 70.0 (9.6%)	Colon/Rectum 41.6 (11.0%)	Colon/Rectum 44.4 (8.6%)
4	Urinary Bladder 30.0 (5.0%)	Stomach 23.2 (3.2%)	Liver & Intrahepatic Bile Ducts 24.5 (8.7%)	Oral Cavity & Pharynx 22.7 (5.2%)

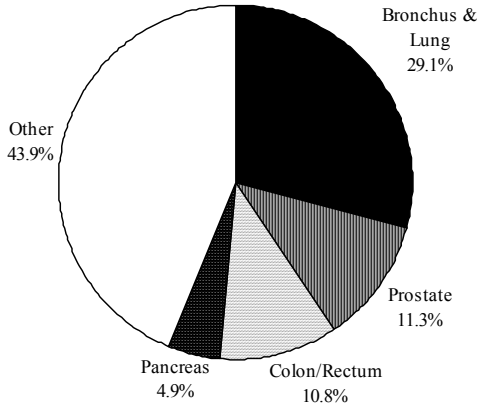
FEMALES

RANK	AGE-ADJUSTED[1] INCIDENCE RATE[2] (% OF ALL CASES)			
	White, non-Hispanic	**Black, non-Hispanic**	**Asian, non-Hispanic**	**Hispanic**
1	Breast 146.3 (31.5%)	Breast 111.4 (30.6%)	Breast 70.0 (27.9%)	Breast 86.6 (28.9%)
2	Bronchus & Lung 59.9 (13.6%)	Bronchus & Lung 49.9 (12.7%)	Colon/Rectum 40.0 (11.7%)	Colon/Rectum 31.5 (9.0%)
3	Colon/Rectum 50.9 (12.6%)	Colon/Rectum 48.0 (12.2%)	Bronchus & Lung 30.8 (9.2%)	Bronchus & Lung 24.2 (6.9%)
4	Corpus Uteri & Uterus, NOS 27.8 (6.0%)	Corpus Uteri & Uterus, NOS 18.6 (4.8%)	Corpus Uteri & Uterus, NOS 12.6 (4.8%)	Corpus Uteri & Uterus, NOS 20.7 (6.7%)

[1] age-adjusted to the 2000 U.S. Standard Population [2] per 100,000

Figure 2
DISTRIBUTION OF CANCER MORTALITY BY CANCER TYPE AND SEX
Massachusetts, 1996-2000

MALES



FEMALES

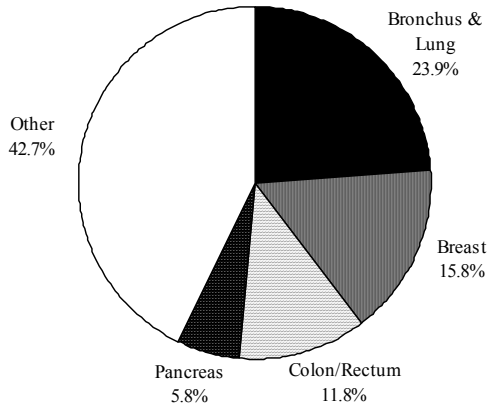


Table 2
LEADING CANCER DEATHS BY SEX AND RACE/ETHNICITY
Massachusetts, 1996-2000

MALES

RANK	AGE-ADJUSTED[1] MORTALITY RATE[2] (% OF ALL CASES)			
	White, non-Hispanic	**Black, non-Hispanic**	**Asian, non-Hispanic**	**Hispanic**
1	Bronchus & Lung 77.2 (29.4%)	Bronchus & Lung 98.8 (27.2%)	Bronchus & Lung 41.9 (25.7%)	Bronchus & Lung 30.2 (20.8%)
2	Prostate 32.7 (11.3%)	Prostate 65.7 (14.4%)	Liver & Intrahepatic Bile Ducts 19.9 (15.5%)	Prostate 20.1 (9.6%)
3	Colon/Rectum 29.5 (10.9%)	Colon/Rectum 40.3 (10.4%)	Colon/Rectum 12.3 (8.8%)	Colon/Rectum 14.7 (9.2%)
4	Pancreas 12.9 (4.9%)	Pancreas 18.7 (5.6%)	Stomach 12.0 (6.4%)	Liver & Intrahepatic Bile Ducts 10.9 (8.0%)

FEMALES

RANK	AGE-ADJUSTED[1] MORTALITY RATE[2] (% OF ALL CASES)			
	White, non-Hispanic	**Black, non-Hispanic**	**Asian, non-Hispanic**	**Hispanic**
1	Bronchus & Lung 45.3 (24.2%)	Bronchus & Lung 43.2 (20.2%)	Bronchus & Lung 21.2 (15.9%)	Breast 12.5 (17.1%)
2	Breast 29.4 (15.8%)	Breast 33.6 (16.5%)	Breast 16.2 (15.3%)	Colon/Rectum 10.1 (11.8%)
3	Colon/Rectum 19.8 (11.8%)	Colon/Rectum 25.6 (11.7%)	Colon/Rectum 12.3 (9.9%)	Bronchus & Lung 9.7 (11.6%)
4	Pancreas 10.1 (5.8%)	Pancreas 14.9 (6.8%)	Liver & Intrahepatic Bile Ducts 9.2 (7.3%)	Non-Hodgkin('s) Lymphoma 5.3 (7.2%)

[1] age-adjusted to the 2000 U.S. Standard Population [2] per 100,000

Massachusetts Incidence and Mortality Compared to the U.S.

Age-adjusted incidence and mortality rates in Massachusetts are compared to national rates in Table 4 (incidence) and Table 10 (mortality). It is important to interpret these data cautiously. The national incidence data are from selected registries participating in the SEER program. While the SEER program has been the leading source for most national cancer incidence data, the data presented in this report from the SEER registries represent a small percentage of the United States population. In general, the SEER program over-represents urban areas and foreign-born people compared to the United States population as a whole. Cancer rates may be affected by such characteristics of the population, as well as by racial/ethnic distribution, the prevalence of cancer risk factors, and cancer screening rates. Cancer rates in Massachusetts and the SEER areas may differ because of these differences. Also, the Massachusetts incidence and mortality data presented in these tables represent cancer cases and deaths from 1996-2000. The SEER incidence and the United States mortality data represent cancer cases and deaths from 1995-1999 (the latest available data from SEER). Thus, the time period presented differs between Massachusetts and the national comparison.

For all cancer sites combined, the age-adjusted incidence rate was higher in Massachusetts than the SEER areas. The Massachusetts incidence rate from 1996-2000 was 501.2 per 100,000, while the rate for the SEER areas was 468.9 per 100,000 from 1995-1999 (Table 4). The incidence rates in Massachusetts were also higher than the incidence rates in the SEER areas for some cancers such as cancer of the bronchus and lung, colon/rectum, female breast, and prostate. However, the incidence rates in Massachusetts were lower than the incidence rates in the SEER areas for other cancer types such as cancer of the liver and intrahepatic bile ducts and cervix (Table 4).

Similarly, the age-adjusted mortality rate in Massachusetts was higher than the age-adjusted mortality rate in the United States for all cancer sites combined, 211.3 per 100,000 vs. 206.0 per 100,000, respectively (Table 10). Massachusetts had a higher mortality rate than the United States for cancers such as bronchus and lung among females and colon/rectum among both males and females. Massachusetts had a lower rate than the United States for some other cancers such as bronchus and lung among males and cervix (Table 10).

Cancer Incidence and Mortality Trends

Incidence

From 1996 to 2000, overall cancer incidence in Massachusetts decreased by 0.2% per year (decreased by 0.8% per year in males and increased by 0.2% per year in females). However, these trends were not statistically significant. Incidence trends in the leading cancers affecting Massachusetts men and women are discussed below. See Figures 3 and 4 and Table 3 for incidence and mortality trends and Table 7 for the age-adjusted incidence rates by year. All of the data describing percent increases and decreases per year are based upon the estimated annual percent change (EAPC).

Males

Among Massachusetts males between 1996 and 2000, the incidence rate of prostate cancer increased by 0.9% per year, though the increase was not statistically significant (Figure 3). The 1996 incidence rate of prostate cancer was 178.3 cases per 100,000 males, and the 2000 rate increased to 186.5 cases per 100,000 males (Table 7). However, there was an overall decrease in prostate cancer from its peak incidence of 217.4 per 100,000 in 1992. Devesa *et al.* attribute national increases in prostate cancer incidence during the late 1980s and early 1990s to changes in diagnostic methodology (10). Transurethral resections were performed more frequently in the 1980s than in the preceding decade, resulting in increased detection of cases which would have been undetectable by clinical means. Other diagnostic procedures (such as serum testing for prostate-specific antigen (PSA), ultrasound-guided needle biopsy, computerized axial tomography (CAT scanning) and bone scanning) have increased the number of prostate cancer diagnoses. Edwards *et al*. suggest that increased PSA screening resulted in the increase in prostate cancer incidence from 1988 to 1992 (11). Wingo *et al.* attribute the downtrends in prostate cancer since 1992 to the identification of prevalent cases through screening, and then the subsequent falling toward an equilibrium, reflecting only incident cases in the population (12). Also, there may have been decreased utilization of PSA screening tests in recent years, which might have been precipitated by recommendations by some organizations against their widespread use during the early 1990s. Clegg *et al*. used SEER data to analyze incidence trends that have been adjusted for reporting error and delay (9). They found that the incidence rate trend for prostate cancer since 1995 among white males was similar to the incidence rate trend before the introduction of PSA testing.

The age-adjusted incidence rate declined for cancer of the bronchus and lung, the second most commonly diagnosed cancer in males. The incidence rate for cancer of the bronchus and lung fell from 90.4 cases per 100,000 males in 1996 to 85.6 cases per 100,000 in 2000 (Table 7) and decreased by 1.6% per year during this time period, though the decreasing trend was not statistically significant (Figure 3). Howe *et al.* attribute the decrease in lung cancer incidence in males to reduction in tobacco smoking since the 1960s (13). Edwards *et al*. explain that tobacco smoking patterns have delayed effects on lung cancer incidence and mortality rates (11).

The incidence rate of colorectal cancer fell from 77.0 cases per 100,000 males in 1996 to 67.7 cases per 100,000 in 2000. The estimated annual percent change indicated a statistically

significant decreasing trend of 3.1% per year for colorectal cancer among Massachusetts males (Figure 3). Troisi *et al.* used SEER data to show overall decreases in the incidence rates of colorectal cancer (14). They noted stage-specific shifts that they attributed to earlier detection, most likely due to screening. Howe *et al.* note that since early-detection methods, such as fecal occult blood testing, sigmoidoscopy, colonoscopy, and barium enemas, can detect pre-cancerous polyps and early-stage carcinomas, it is difficult to separate the effects of screening from true changes in the incidence of colorectal cancer (13).

The incidence of cancer of the urinary bladder decreased among Massachusetts males. In 1996, 32.3 males per 100,000 were diagnosed with cancer of the urinary bladder. By 2000, the incidence rate fell to 26.7 per 100,000 (Table 7). Among Massachusetts males, the incidence rate of cancer of the urinary bladder decreased by 6.3% per year from 1996 to 2000, though the decrease was not statistically significant (Figure 3).

In addition to the statistically significant incidence trend already mentioned, there were statistically significant trends from 1996 to 2000 for cancer of the esophagus (an increase of 3.3% per year), larynx (a decrease of 4.3% per year), and non-Hodgkin('s) lymphoma (a decrease of 2.8% per year) among Massachusetts males.

Females

Among Massachusetts females, breast cancer incidence increased slightly between 1996 and 2000. The incidence rate increased from 141.4 cases per 100,000 females in 1996 to 142.9 cases per 100,000 in 2000 (Table 7) and by 0.2% per year, though the increasing trend was not statistically significant (Figure 4). Devesa *et al.* attribute most of the increase in national breast cancer incidence to the earlier detection of tumors resulting from increasing use of mammography and other screening techniques (10). Other contributing factors may include changes in diet, alcohol consumption, the long-term use of hormone replacement therapy, and certain reproductive variables (such as later age at first childbirth).

The incidence of cancers of the bronchus and lung continued to increase among Massachusetts females, rising from 56.4 cases per 100,000 females in 1996 to 59.9 cases per 100,000 in 2000 (Table 7). During this time period, the incidence rate increased by 1.1% per year among Massachusetts females, though the increase was not statistically significant (Figure 4) Wingo *et al.* note that the prevalence of smoking in women has lagged behind that in men, reaching a peak of 55% in the cohort of women born between 1935 and 1944 (15). Consequently, the incidence of lung cancer is still increasing in women, reflecting the historical pattern of cigarette smoking.

The third most common cancer among Massachusetts females, colorectal cancer, decreased from 52.6 cases per 100,000 in 1996 to 48.8 cases per 100,000 in 2000 (Table 7). The trend for colorectal cancer among females during this time period was a decrease of 1.9% per year, though the decrease was not statistically significant (Figure 4). Uterine cancer, the fourth most common cancer among Massachusetts females, decreased from 1996 to 2000 by 0.5% per year, though the decrease was also not statistically significant (Figure 4). The 1996 incidence rate of 27.2 cases per 100,000 females fell to 25.7 cases per 100,000 in 2000 (Table 7).

Among Massachusetts females, there were statistically significant trends from 1996 to 2000 for cancer of the cervix (a decrease of 9.1% per year), thyroid (an increase of 14.4% per year), and urinary bladder (a decrease of 7.3% per year).

Mortality

When cancer mortality rates are compared from 1996 to 2000 certain changes are notable. For all cancer sites combined, the mortality rate in Massachusetts decreased by 1.8% per year from 1996 to 2000 (Figure 3). This decrease was statistically significant. For males, decreasing death rates have been observed nationally and in Massachusetts for lung and prostate cancers (Figure 3). The decrease in mortality of cancer of the bronchus and lung in Massachusetts males was statistically significant at 2.5% per year (Figure 3). Wingo *et al.* attribute decreasing national lung cancer mortality rates in men to decreased smoking rates over the past thirty years (15). The explanation for the decline in prostate cancer mortality is uncertain. According to Howe *et al*., it is not yet known how PSA screening will affect prostate cancer mortality because of other simultaneous changes, such as more aggressive treatment of early disease (13).

For Massachusetts females, lung cancer replaced breast cancer as the leading cause of cancer deaths in 1989. From 1996 to 2000, breast cancer death rates declined significantly by 4.3% per year (Figure 4). Wingo *et al.* attribute the downtrend in national breast cancer mortality to the incorporation of breast cancer screening into routine medical care (12). Advances in the treatment of breast cancer have also contributed to the decline in breast cancer mortality.

For Massachusetts males and females combined, the mortality rate of colorectal cancer decreased by 2.7% per year from 1996 to 2000 (Table 9). This decrease was statistically significant. Wingo *et al.* suggest several possibilities for the decreases in incidence and mortality of colorectal cancer, including increased polyp removal, advances in treatment protocols (e.g., new surgical techniques and adjuvant therapies), and other factors, such as changes in dietary patterns (12).

In addition to the statistically significant mortality trends already mentioned, there were statistically significant decreases in the age-adjusted mortality rates from 1996 to 2000 for all cancer sites combined and non-Hodgkin(’s) lymphoma for Massachusetts males, and for cancers of the colon/rectum and stomach for Massachusetts females. During this time period, there was a statistically significant increase in the age-adjusted mortality rate for cancer of the esophagus for Massachusetts males.

T A B L E S

APPENDICES

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